मध्य भारती

मानविकी एवं समाजविज्ञान की द्विभाषी शोध-पत्रिका

ISSN 0974-0066

CERTIFICATE OF PUBLICATION

This is to Certify that the article entitled

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Published in

Madhya Bharti-Humanities and Social Sciences

Vol-83, January-June 2023

ISSN: 0974-0066 Peer Reviewed Refereed UGC Care Listed Journal

Impact Factor: 6.4

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BRIDGING THE GAP BETWEEN THE PAST AND PRESENT: THE ROLE OF INFORMATION TECHNOLOGY IN ARCHAEOLOGICAL RESEARCH OF PETROGLYPHS IN THE KONKAN REGION OF MAHARASHTRA, INDIA

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ABSTRACT

Petroglyphs etched on laterite rocks are reported from the Konkan coast in Maharashtra, specifically from Ratnagiri and Sindhudurg districts. These rock carvings are one of the many forms of rock art, serving as a medium of communication used by the ancient people in the region. They constitute a valuable and unique archaeological resource that provide an insight into the cultures and societies of the past. The paper, Bridging the Gap between the Past and Present: The Role of Information Technology in Archaeological Research of Petroglyphs in the Konkan region of Maharashtra, India, explores the role of Information Technology (IT) in archaeological research of the Konkan petroglyphs. By incorporating IT tools such as Big Data, GIS and image processing, we aim to enhance our understanding of the petroglyphs from Konkan and their significance. The research illustrates how the use of Information Technology can aid in the identification, analysis and interpretation of petroglyphs and contribute to a more comprehensive understanding of the past. The paper has significant implications for the field of archaeology, highlighting the potential for Information Technology to deepen our knowledge of Maharashtra's rich archaeological heritage.

KEYWORDS: Rock Art, Petroglyphs, Laterite, Konkan, Information Technology, Image Processing, Remote Sensing, Render Images

INTRODUCTION

Archaeology is a fascinating field that delves into the human past through the analysis of material remains in the form of artefacts, structures and other physical objects. By analysing the remains, archaeologists can gain an insight into the past. It is a multidisciplinary and interdisciplinary field that draws on a range of natural and social sciences, including biology, geology, history, anthropology and such others to provide a holistic understanding of the past societies and cultures. The multidisciplinary nature of archaeology makes it a reliable field of study to interpret and reconstruct the past. Revolutionary advancements in Information Technology have significantly contributed to archaeological research. Furthermore, the integration of Information Technology has led to the emergence of 'computational archaeology', which describes computer-based analytical methods for the study of long-term human behaviour and behavioural evolution. This interdisciplinary field has revolutionised the way in which archaeologists approach the study of the ancient times, leading to a more comprehensive understanding of the human past.

Petroglyphs are one of the oldest surviving forms of artistic expression of man left behind from the remotest times. Petroglyphs are designs and patterns created on rocks by removing the patina or surface layer to expose the underlying unweathered rock material of a different colour, resulting in a deeper mark that appears in relief. These rock art figures and motifs are made using various techniques such as carving, engraving, pounding, pecking, drilling, boring or incision. With the abundance of rock surfaces available to man, these formed the primary choice for

depiction of creative expressions and we see the petroglyph form of rock art all over the world. Petroglyphs are also found throughout the length and breadth of India. Discovery of the carved designs in the Konkan region has yielded undeniable evidence of the practice of creating petroglyphs on the western coast of India. In recent trends, IT has shown great participation with the image processing system, which helps to render images and analysing patterns using machine learning techniques.

RATIONALE FOR THE STUDY OF THE ROLE OF INFORMATION TECHNOLOGY IN ARCHAEOLOGICAL RESEARCH OF PETROGLYPHS IN THE KONKAN REGION

Petroglyphs are found in the Konkan region with dense concentration in Ratnagiri and Sindhudurg districts of Maharashtra. The first reported petroglyph in the region was at Ratnagiri in the 1990s, and subsequent findings of similar petroglyphs occurred sporadically. It is only in the recent years that systematic recording and study of the petroglyphs has been undertaken by the auspices of the Directorate of Archaeology and Museums, Maharashtra and local enthusiasts. This has resulted in the discovery and meticulous documentation of several petroglyphs scattered throughout the region.

Although the number of petroglyphs discovered in the region has exceeded two thousand, and continues to rise with ongoing explorations, details about the people who created them, the techniques and tools employed in their creation or the time period of their creation remain enigmatic. This present paper attempts to bridge the gap between the past and the present by incorporating Information Technology to analyse the petroglyphs and garner new understanding of the archaeological data. Through this integration of the past's creations and the present technology, we aim to take a step further in solving the mysteries of Konkan's petroglyphs.

PREVIOUS RESEARCH

Reports published in local newspapers by amateur enthusiasts played a crucial role in instigating a comprehensive scientific study and exploration of the petroglyphs in Konkan. The first reported site of petroglyphs was Nivali, which was brought to the attention of the Directorate of Archaeology and Museums' Ratnagiri division when road widening work endangered the carvings. Subsequent publications in Marathi provided information about other petroglyph sites in the region. Ghanekar's book on tourism in Konkan titled 'Kokanatil Paryatan', in Marathi language, mentions the petroglyph sites of Nivali Phata and Barsu (Ghanekar 1995, 156-176). Dawood Dalvi's 'Maharashtratil Leni', published in Marathi, mentions petroglyph sites of Devihasol, Barsu and Nivali (Dalvi 1990, 34-43). In his book 'Kokanatil Katalshilpe aani Sindhu Sanskruti', Ravindra Lad associated the creators of petroglyphs as belonging to the Harappan civilisation based on the similarity between the petroglyph of a human figure with outstretched arms and two tigers on either side of the arms at the site of Barsu and a similar motif on seals from the Harappan civilisation (Lad 2018). The book also studied a few other sites, including Nivali and Devihasol, and the motifs and patterns represented there. Public awareness and village-to-village survey conducted by individual scholars and the Directorate of Archaeology and Museums, Maharashtra led to the discovery of numerous new petroglyph sites throughout Ratnagiri (Garge, et al. 2018).

While commendable work has been done in the field of archaeological explorations, documentation and study; there has been limited effort to integrate Information Technology in the research of petroglyphs in Konkan. Archaeology has traditionally used 3 methods to document rock art graphically- free hand drawing, rock rubbing and photography. One of the most common techniques involves taking an impression by means of tracing paper. To do this it is necessary to super impose the paper on the stone in question and rub it with a pencil or

charcoal. In this way it is possible to observe quite precisely the characteristics of the figure that forms the petroglyph. The edges that stand out from the stones are those that are outlined by the tracing paper. A problem with this method is that it can damage the stone when brushing it in such a way.

THE PETROGLYPHS OF KONKAN

Petroglyphs refer to a category of ancient artistic expressions that entail carving or pecking out patterns or designs onto the surface of a rock. Any expression about human feelings or imagination that is made perceptible through the sensory organs is Art. In the absence of literature, art forms in the remote past included dance, song and other mediums of expressing human emotions. Meenakshi Pathak defines art as, "the communication of a conception through a medium" (Pathak 2013, 197). Thereby, artwork is an expression that seeks communication, a communication which can be sought through the study of the artwork itself. The beginning of humanity's artistic expedition can be traced back to the works of art left behind by our earliest ancestors on natural rock surfaces in the remote past. Rocks being extensively available, right from the beginning, we find various forms of rock art throughout the world, often dating back thousands of years. Rock Art represents the largest body of evidence possessed by us in regard to our cognitive, artistic and cultural beginnings. Serving as the most substantial evidence of our cultural development throughout our existence, prehistoric rock art constitutes a significant aspect of the collective memory of the whole of humanity.

The term 'rock art' is quite self-explanatory, marking made on the natural surface of rocks by human beings is known as rock art. Pictographs (drawings or paintings), petroglyphs (carvings or inscriptions), engravings (incisions), petroforms (rocks laid out in patterns) and geoglyphs (enormous ground engravings or carvings) are the several forms of rock art. A scientific definition of rock art, as given by Bednarik, is thus, "Rock art consists of markings occurring on rock surfaces that were 'intentionally' produced by members of the genus Homo (i.e. anthropic marking), that are detectable by 'normal human sensory faculties' and that are concept-mediated externalisations of a 'conscious' awareness of some form of perceived society" (Bednarik 2007, 1). Two key techniques are employed in the creation of rock art - Additive process and Reductive process. The adoption of either of the two techniques results in the formation of two principal branches of rock art. In the additive process, a material such as pigment is applied to the surface of the rock, resulting in the formation of rock paintings or pictograms. This branch of rock art includes pigment drawings, stencils and beeswax figures. The Reductive process involves the removal of patina on the rock, resulting in the creation of petroglyphs. In essence, 'rock paintings' and 'petroglyphs' (rock engravings/carvings) are two major classifications of rock art based on the techniques used in their creation.

The artworks form a medium of communication used by the contemporary man of a long lost past. They depict a representation of his understanding about his surroundings. Human beliefs and practices, especially of the pre-historic people, can be studied by means of rock art since they are an expression of the life of people who did not leave behind any written records, and whose life ways are difficult to reconstruct from other material remains left behind of their time.

These artistic expressions of early man, portrayed in the petroglyph form of rock art, are found almost all over the world. The portrayals of such expression are found in India too, all over the length and breadth of our vast country. The most recent discovery of petroglyphs in India is in the state of Maharashtra. Found in the coastal region of Konkan, the petroglyphs give an exclusive peek into the life and times of the prehistoric man in the region. The map illustrates the location of some of the significant petroglyph sites in the Ratnagiri region of Konkan (Fig. 1).

Fig. 1 - Some Petroglyph Sites Shown on a Map of Ratnagiri

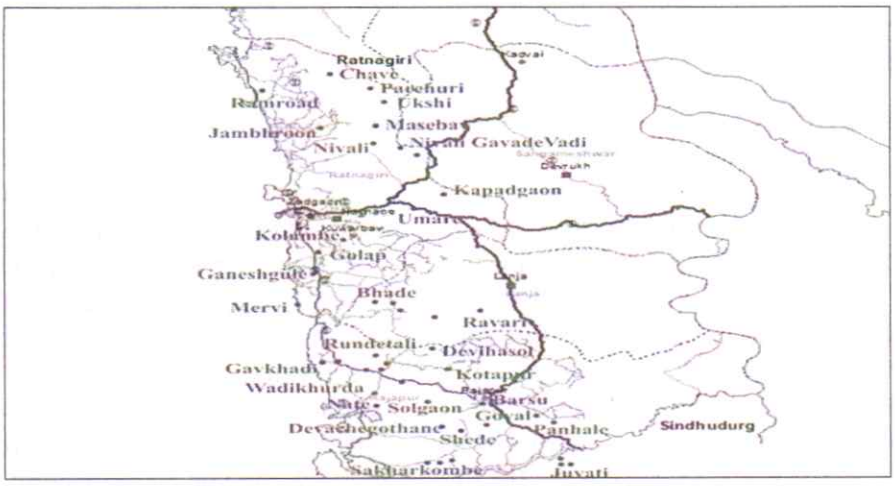


Image Source: (Garge, et al. 2018)

Although the number of petroglyphs in the region exceed one thousand, for the current research the petroglyphs at 5 sites are chosen. The selected sites are: Barsu, Chave, Devihasol, Kasheli and Rundhetali. The sites chosen for the current research are illustrated in the map given above.

Since the petroglyphs are a mode of communication that relies on visual representation, they can be best understood through their visual impact. Therefore, a short description of the petroglyphs as given under may aid in comprehending meaning and significance of the carvings and incisions in stone.

Located a few kilometres away from the village of Barsu, the petroglyphs at the site of Barsu depict a human figure with two animals that can be identified as tigers. The figures are all larger than life in size with the human standing in the middle and the arms outstretched, the two tigers are shown on either side of the human figure by the side of the outstretched arms. It may be depicting the human to be holding the two tigers or that the two tigers are leaping at the human. The tiger depictions contain unique markings that are created by removing surface material to represent the stripes of the tigers thereby giving a very realistic identity to the tigers in the petroglyph; also some designs can be seen carved in the chest portion of the human figure. Below the outstretched left arm of the human, two animal petroglyphs, smaller in size, are visible of which one appears to be a fish, while the other may be identified as a pig, given the prominent representation of its snout. All the petroglyph figures at Barsu are created by removing the surface of the outline of the figure. As a result, the figures and their designs stand out in a darker shade of the natural rock surface, while the outlines are lighter in shade bringing highlight to the petroglyph as can be seen in Fig. 2.

Fig. 2 - Aerial Picture of the Barsu Petroglyph

The petroglyph site of Chave consists of three human figures and three animal figures (Fig. 3) and is located on the boundary of the present village of Chave. Of the three human figures, one is depicted without a clear head structure and a prominent bulge in the belly portion, with legs wide open and bent at the knees; the arms of the figure appear straight. The other two human figures are shown standing in similar positions; the only difference between them appears in the depiction of the shape of their heads, while one figure has a slightly rounded head portion and is shown holding some object in its left hand; the other one is depicted as having a more square-type head and has two circles, one inside the other, by its right hand. Along with these human figures are also found the petroglyphs of three animal figures at Chave. The three animal representations show one front leg and one hind leg, with the remaining leg hidden behind the depicted ones. All the animal figures are found next to the two standing human figures, the diversity of shapes and designs is clearly visible in the sketch of the petroglyphs (Fig. 4). The outlines of the figures at Chave have a lighter coloured outline, since they are made by removing the surface of the rock in a thin line of the desired shape of the figure to be represented; while the figure depicted is of the same colour as the surrounding surface.

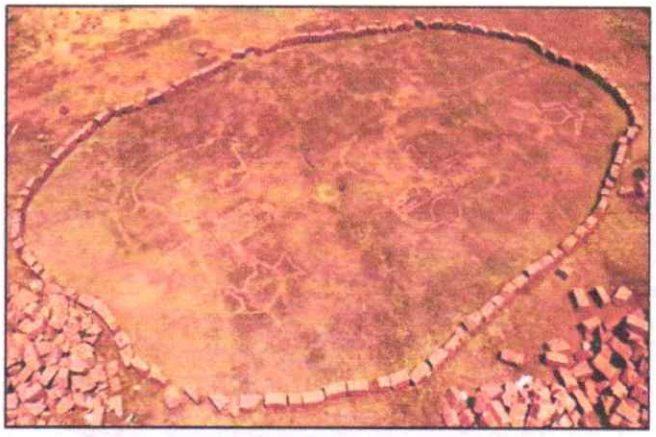
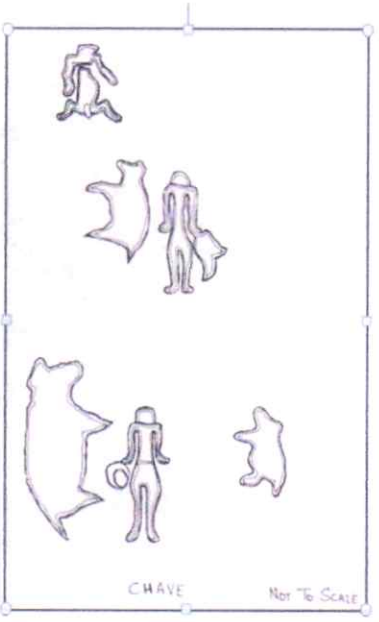


Fig. 3 - Aerial Picture of the Petroglyphs at Chave



Numerous abstract designs carved in a pattern are found at the site of Devihasol near the temple complex of Goddess Aryadurga. The pattern is carved in rectangular shape in deep relief with smaller and smaller rectangular divisions throughout the pattern filled with abstract forms (Fig. 5). Although the petroglyph is unquestionably different from the petroglyph at Barsu; it is made in a technique similarly to the latter, in the sense that the surface is dug to a considerable depth in order for the relief to be highlighted.

Fig. 5 - Aerial Picture of the Abstract Petroglyph Design at Devihasol

Situated in the remote part of Ratnagiri is the site of Kasheli housing, perhaps, the most inimitable of all the petroglyphs found in the whole of Konkan. Kasheli petroglyph is uniquely characterised by the carving of a huge elephant. Inside the elephant petroglyph are carved smaller petroglyphs of other animals, both terrestrial and aquatic, birds, as well as certain abstract designs. Two tiny elephants, a few more animals and an abstract design are found carved outside of the elephant body. Perhaps only an aerial image can do justice to the magnificence of the petroglyph at Kasheli (Fig. 6).

Fig. 6 - Aerial Picture of the Petroglyphs at Kasheli

The petroglyphs at Rundhetali also consist of a huge pattern carved in relief in a circular shape, filled with numerous abstract designs. By the pattern lay the carving of just two human legs, depicting the portion from the knees to the feet; this phenomenon, however, is consistent at almost all the relief pattern petroglyphs. Next to the relief pattern are found two aquatic figures and an animal figure. Fig. 7 is a sketch of the petroglyph that makes the abstract relief designs and other figures clearly visible.

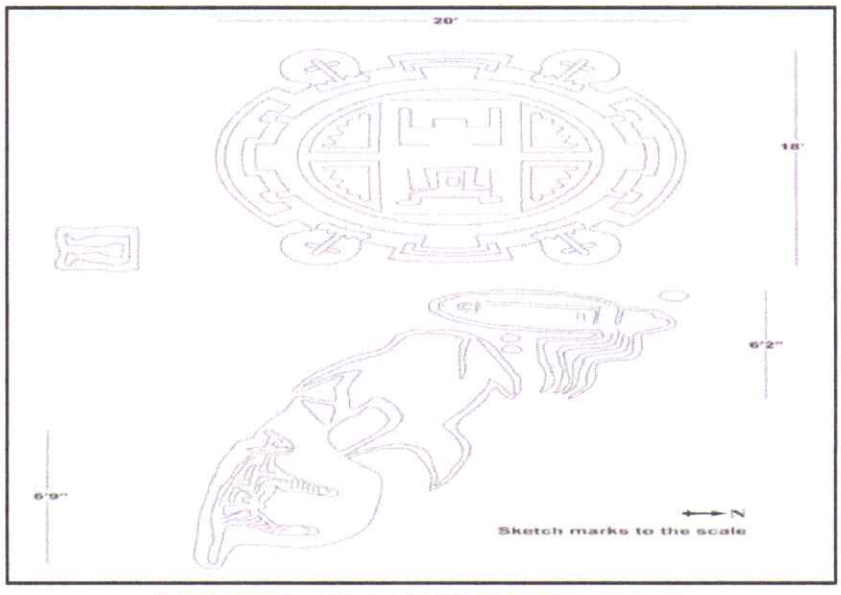


Fig. 7 - Sketch of the Rundhetali Petroglyphs

(Image Source: Directorate of Archaeology and Museums, Maharashtra)

ROLE OF INFORMATION TECHNOLOGY IN THE STUDY OF KONKAN PETROGLYPHS

The use of digital technology in archaeology allows for the non-intrusive analysis, documentation, and reconstruction of data, historical sites, and artefacts, allowing archaeologists to preserve the data and cultural heritage contained within these archaeological findings. As information communication technology advances in the field of archaeology, archaeologists gain greater access to these technologies, allowing greater amounts of archaeological data to be accurately documented and analysed.

1. Software for the operating system

Image processing software has been specifically designed for the ACW system. High-resolution images that are too large for direct display may be shown in their entirety at lower resolution and portions may be displayed at full resolution or after additional processing magnification. There are two ways to manipulate images in greyscale to improve contrast. The grey-level transformation required in the first of these is the user specifies it directly. The shape is specified by the user in the second method required for the transformed image's grey-level histogram, and the system.

The corresponding grey-level transformation is computed. In each instance, the system displays the histogram's shape before and after transformation. Convolutions are one of the more specialised techniques implemented on the system edge detection, sharpening, and smoothing the use of simple imaging techniques on geophysical data has been extremely beneficial successful in improving output quality.

DISCUSSION

Based on the paper mentioned above, it is proposed that the study of petroglyphs can greatly benefit from the integration of Information Technology. Ground based remote sensing is a successful tool that can detect petroglyphs. A major limitation of the software is that it does not provide orthocorrection of terrestrial images as it was primarily developed for satellite imaging, thereby leading to additional constraints. Since the petroglyphs of Konkan are all carved on laterite surface, vegetation hinders the visual impact of the designs. However, the application of IT can help with the removal of all traces of micro-vegetation and pigment on the stone through repair and cleaning work using chapel. The petroglyphs that are the focus of the current paper can be highlighted and verified by the digital processing, including Gaussian 3x3 filtering, adaptive enhancement and inverse imaging.

In the broader scope, IT can contribute in digitizing the petroglyphs and creating a database, which will make it easier to analyze and interpret the images, allowing a more efficient and accurate study of the petroglyphs. The utilisation of IT tools such as 3D scanning and visualisation can provide a better understanding of the physical and spatial characteristics of the carvings. The integration of IT has the potential to significantly enhance research into petroglyphs and offer valuable insights into ancient cultures and societies, perhaps it may also provide insights into the creators' identity, beliefs and lifestyles. Furthermore, with the aid of IT, researchers can preserve and document these significant cultural heritage sites for future generations.

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